ERRATA

The Editor and Editorial Committee of the Los Angeles County Museum of Natural History Contributions in Science regret that three references to scale of illustrations were incorrectly designated in OCCURRENCE OF A GIANT BISON, Bison latifrons, AND A SLENDER-LIMBED CAMEL, Tanupolama, AT RANCHO LA BREA, Los Angeles County Museum Contributions in Science, number 147.

The corrections should read as follows:

Page	Figure	Published scale	Corrected scale
2	1	1-1/2	1
5	3	1/2	1/4
6	5	1/2	1/4

We also take this opportunity to stress that you make these changes in your copy of Contributions 147 rather than insert this mimeographed sheet.

We regret these inconveniences.

Dorothy M. Halmos,
Editor

Robert J. Lavenberg,
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A NEW CENTRAL AMERICAN SAND FLY BREEDING IN CRAB HOLES (DIPTERA, CERATOPOGONIDAE)

By Charles L. Hogue[1] and Willis W. Wirth[2]

Abstract: The larva, pupa, and adult of a new species of sand fly, *Culicoides cancer*, are described and figured from material collected in Costa Rica. The species is a member of the Furens Group but is unique in its lack of anthropophily and in its breeding site, the burrows of the land crab, *Cardisoma crassum*.

Sand flies of the genus *Culicoides* almost universally utilize, as their larval habitat, the shore lines of tidal swamps and estuaries where they often become extremely numerous. If the females of the species show a preference for human blood, they may become almost intolerable pests when man invades this environment. One group of salt marsh sand flies which has become notorious in the American tropics is the Furens Group, which contains four species, *C. furens* (Poey), *C. barbosai* Wirth and Blanton, *C. gorgasi* Wirth and Blanton, and *C. alahialinus* Barbosa, all causing annoyance to man.

The senior author recently discovered a fifth member of this group living in crab holes on the Pacific coast of Costa Rica. During the six-week period of these investigations, this crab hole species was never observed to bite man, although *C. gorgasi* and *C. barbosai* (during other periods in the study area) were frequently taken while biting. *Culicoides furens* has been collected while biting man at Golfito, also on the Pacific coast of Costa Rica.

At Boca de Barranca, Golfo de Nicoya, and at Playas del Coco, Peninsula de Nicoya, the new species, which we are naming *C. cancer* because of its association with land crabs, was collected and reared from 36 separate collections from burrows of the mouthless crab, *Cardisoma crassum* Smith, and from one burrow of the wide red land crab, *Ucides occidentalis* (Ortmann). It was not found on the Atlantic coast, but two collections from burrows of *Cardisoma guanhumi* Linnaeus at Cahuita (22 miles south of Limón) yielded a species of another group, *Culicoides reticulatus* Lutz, which has been reared from crab holes in Brazil (Forattini, Rabello, and Pattoli, 1958). A third species, *C. arubae* Fox and Hoffman, has been reported from crab holes in the Dutch West Indies (Fox, 1942: 420; Fox and Hoffman, 1944: 109), but according to Jones and Wirth's (1958) observations in Texas, it is more likely to be found in open salt water pools.

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Culicoides cancer new species
(Figs. 1-13)

Diagnosis: This species is most similar to *Culicoides gorgasi* Wirth and Blanton, but may be separated as follows:

	gorgasi	*cancer*
Antennal sensorial pattern	3, 8-10	3, 6-10
Halter color	dark	pale
Leg bands	faint	dark
Apices wing veins M_2 and M_{3+4}	dark	pale
Female eyes	contiguous	narrowly separated
Female spermathecae necks	not tapered	tapered
Male parameres	no ventral lobe	large ventral lobe
Male aedeagus	simple tip	3-pointed tip
Male apicolateral processes	short	long

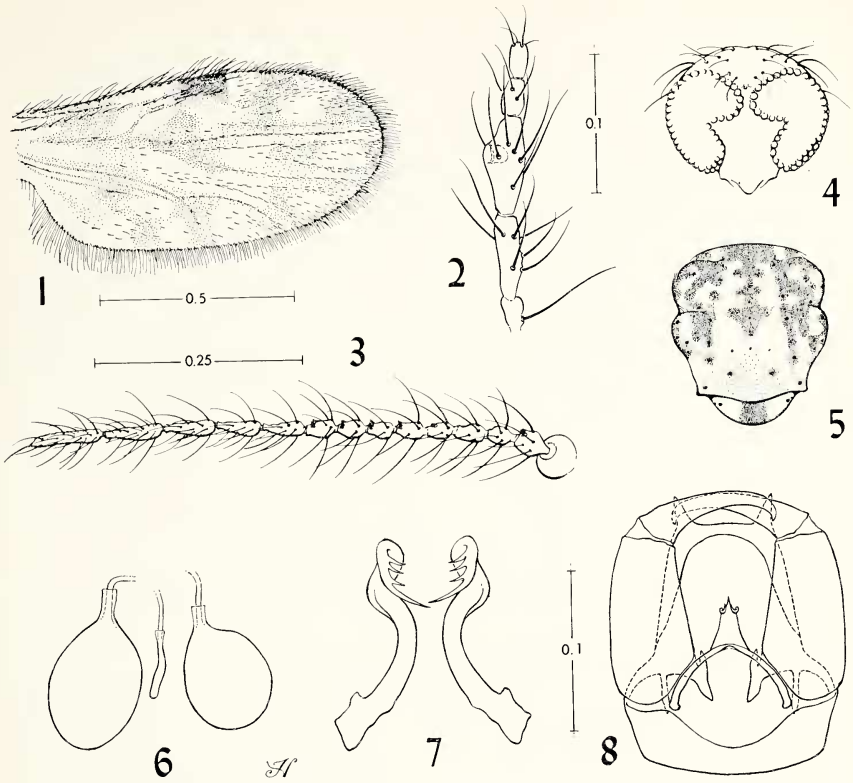
Description (terminology and abbreviations follow Jamnback, 1965: 15-20):

FEMALE. Length of wing 0.91 mm, breadth 0.45 mm.

Head: Eyes (Fig. 4) bare, separated by a distance equal to the diameter of an eye facet. Antenna (Fig. 3) with lengths of flagellar segments in proportion of 16-12-13-13-14-13-13-13-19-20-23-26-35, AR 1.14; distal sensory tufts present on segments three (two per segment), six (one), seven to ten (three per segment). Palpal segments (Fig. 2) with lengths in proportion of 5-10-12-5-5; third segment moderately swollen, with a small, round, moderately deep, sensory pit; PR 2.4. Proboscis moderately long, P/H ratio 1.2; mandible with 16 teeth.

Thorax: Yellowish brown; scutum with prominent pattern (Fig. 5) of dark brown punctures at bases of the coarse, sparse, setose vestiture; scutellum pale on sides, dark brown in middle; postscutellum and pleuron brown. Legs brown, knee spots blackish; trochanters and bases of femora pale; femora with subapical, and tibiae with subbasal, narrow pale rings, hind tibia pale on distal fourth; hind tibial comb with four spines, the one nearest the spur the longest.

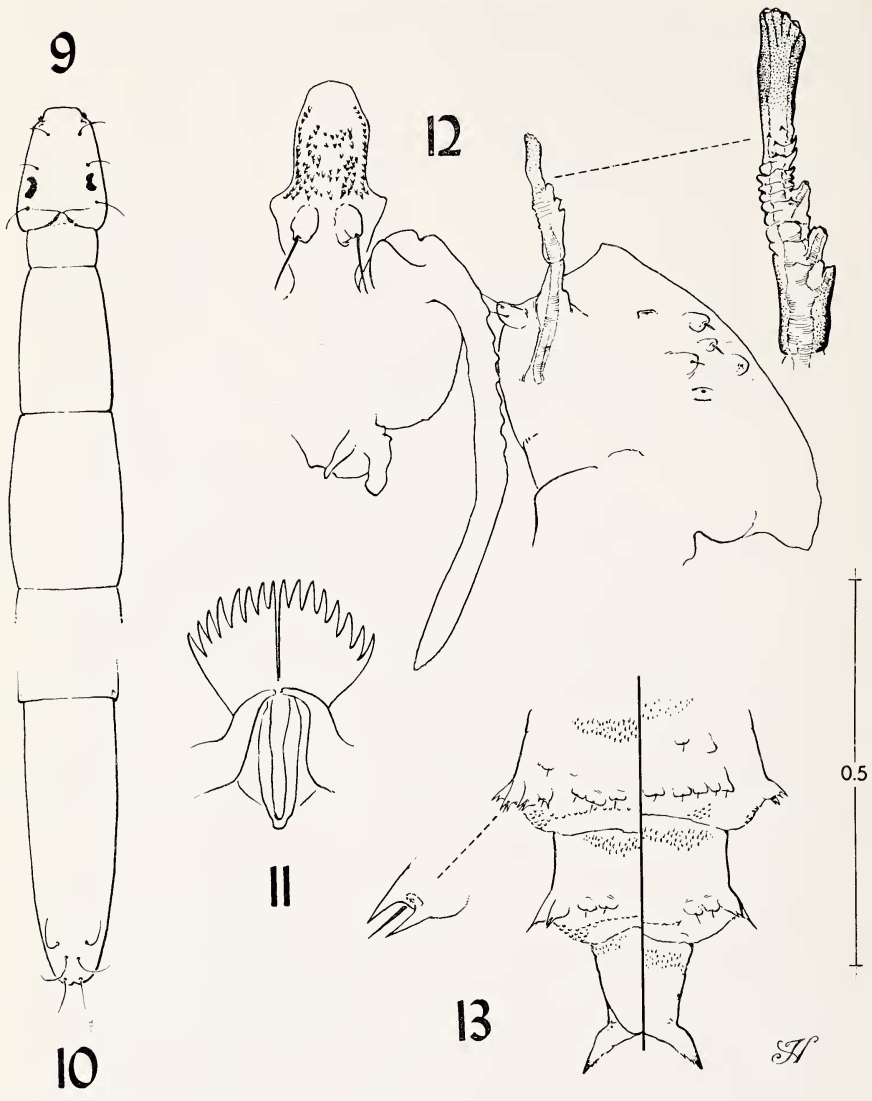
Wing (Fig. 1): Pattern as figured, pale spots distinct, creamy colored; second radial cell dark to tip; base of wing broadly pale except at basal arculus; large pale spot over r-m crossvein extending broadly from costa to media; post-stigmatic pale spot small, confined to anterior wing margin just past second radial cell; a second, separate, elongate pale area lying behind it on anterior side of vein M_1 and extending proximad for length of second radial



Figures 1-8. *Culicoides cancer* n. sp. 1-6, Female: (1) wing; (2) palpus; (3) antenna; (4) eye separation; (5) thoracic pattern; (6) spermathecae. 7-8, Male: (7) parameres; (8) genitalia, parameres removed.

cell; distal pale spot in cell R_5 large, quadrate to trapezoidal in form, extending broadly from anterior wing margin to vein M_1; cell with two elongate pale spots, the second continued as a narrow line to wing margin; cell M_2 with pale streak from base to level of middle of cell M_4, a separate, large, rounded pale spot apically at wing margin; cell M_4 with large rounded pale area broadly meeting wing margin; anal cell with two distal pale spots and pale streaks basally and at margin on anal angle; vein M_1 pale bordered more than halfway to base, apices of veins M_2 and M_{3+4} with small pale spots at wing margin. Macrotrichia moderately dense and long on distal portion of wing, continued very sparsely to bases of cell M_2 and anal cell; CR 0.6; radial cells with distinct lumens. Halter pale.

Abdomen: Brownish. Spermathecae (Fig. 6) two, plus rudimentary third



Figures 9-13. *Culicoides cancer* n. sp. 9-11, Larva: (9) head and thorax; (10) terminal segments and setae; (11) frontoclypeus. 12-13, Pupa: (12) thorax and head sclerites; (13) terminal abdominal segments.

and sclerotized ring; slightly unequal in size, measuring 0.065 mm by 0.038 mm and 0.053 mm by 0.035 mm; ovoid in shape with very long, tapering, slender necks.

MALE. Similar to the female with the usual sexual differences; antennal plumes well developed. Genitalia (Figs. 7-8): Ninth sternum with moderately broad and deep caudomedian excavation, the ventral membrane bare; ninth tergum moderately long and slightly tapering, with moderately long and slender, pointed, slightly divergent, apicolateral processes, the caudal margin between them slightly convex. Basistyle moderately slender, slightly tapering, ventral root foot-shaped, with well-developed caudal heel and sharp anteromedian toe; dorsal root slender; dististyle slender and gradually curved, with abruptly bent, sharp tip. Aedeagus with broad, rounded, anterior basal arch extending to 0.6 of total length, the basal arms slender; distal portion broad on shoulders, tapering distally, with three subequal sharp points apically, the lateral pair abruptly bent ventrad. Parameres (Fig. 7) each with small basal knob, stem slender and sinuate, subapically with a small ventral lobe; distal constricted portion bent ventrad and mesad and tapering to sharp point with fringe of four to five sharp lateral spines.

MATURE LARVA (Figs. 9-11). Head pale yellow, elongate, length of frontoclypeus 130 (n = 3) microns; comb with 5-8 (average 6.8, n = 9) teeth on each side. Thorax without pronounced pigmented areas. Setae on last segment as figured.

PUPA (Figs. 12-13). Respiratory horn light brown, similar in color to rest of pelt except slightly darkened apically and basally, typically with four apical and three lateral spiracular openings on pronounced protuberances, with weak transverse convolutions at midlength, without spines; horn slender, widest near base, Length/Width ratio 6.3-7.2. Operculum with short, broad-based spines abundant over most of surface; *am* setae about one-half as long as maximum width of operculum. The *d* tubercles arranged as figured, setae 1 and 2 short and heavy, not overlapping; seta 4 short. Abdomen with *lmp* tubercles bifid with sharp points and a subapical seta. Last segment with sparse weak spines cephalad, none on disc; caudal apicolateral processes with a few spines caudad, apex only darkened, directed caudad at an angle of approximately 40 degrees to the longitudinal axis of the body.

Distribution: Pacific coast of Costa Rica.

Material: HOLOTYPE. Female, allotype male, Boca de Barranca, Golfo de Nicoya, Puntarenas Prov., Costa Rica, 27 June 1967, C. L. Hogue and D. B. Bright, reared from burrow of *Cardisoma crassum*, LCBA 111 (deposited in Los Angeles County Museum of Natural History).

PARATYPE. 21 males, 18 females, same data as holotype, except dates 20 June to 11 July 1967 (LCBA 2, 11, 112, 126, 147, 135, 142, 177, 111, 160, 142). Also one male, one female, same data but from burrows of *Ucides*

occidentalis, 10 July 1967 (field no. CR 240). Also five males, one female, Playas del Coco, Peninsula de Nicoya, Guanacaste Prov., 18 July 1967, C. L. Hogue and D. B. Bright, from burrows of *C. crassum* (LCBA 230).

ADDITIONAL MATERIAL. Numerous specimens, primarily of larvae and pupae, Boca de Barranca, Golfo de Nicoya, Puntarenas Prov., Costa Rica (LCBA collections as follows: 2, 3, 11, 104-106, 111-112, 123-126, 135, 137-139, 141-144, 147-150, 159-161, 163-165, 167-168, 170-171, 177) and Playas del Coco, Peninsula de Nicoya, Guanacaste Prov., Costa Rica (LCBA 205 and 230). All collected by C. L. Hogue and D. B. Bright.

Biology: All of the present material was collected during mid-rainy season in burrows of moderate to large diameter (1.5 to 5 inches) occupied by half-grown to mature crabs. The larvae were extremely numerous at times, breeding in the water which collects from ground water seepage and rainfall. The burrow water varied considerably in solute concentrations, depending on the proximity of a particular burrow to, and the nature of, a nearby water source (fresh-water stream, tidal inlet, tidal mangrove thicket or the open sea). Immatures were collected primarily from burrow water with low salt concentrations (ranging from 15-580 ppm NaCl) though they were frequently found, sometimes thriving in dense numbers, in water with moderate (1900-8600 ppm NaCl) or even high (13,000-26,000 ppm NaCl) salt concentrations. A few burrows emitted strong sulfide odors and contained black water, indicating that considerable organic decomposition was taking place therein; though in most cases the water was less putrid, it was always turbid (dark brown to grey in color) and rich in organic matter (principally plant fragments brought into the burrow by the crab host).

The foregoing indicates that the larvae and pupae of this species have a wide range of tolerance in regard to variation in the chemistry of its medium. This tolerance is shared by most of its associates and appears to be a general characteristic of estuarine and crabhole invertebrates, doubtless an adaptation permitting them to survive the extreme fluctuations, mainly in salt concentration, common to their environment.

Associated with *Culicoides cancer* at Boca de Barranca and Playas del Coco were crabhole mosquitoes (*Deinocerites pseudes* Dyar and Knab, and *Deinocerites* sp. A. Belkin and Hogue), *Culex inflictus* Theobald, unidentified water mites, and the larva of an unidentified marsh beetle (Helodidae).

Adult *Culicoides cancer* rest on the walls of the burrow throat and mouth. They are agitated readily by debris falling into the burrow and by any object (such as an aspirator) being thrust into the burrow. Under these circumstances they crawl rapidly over the soil inside the burrow and fly swiftly out of the burrow mouth, landing on the soil surface or vegetation very close by. They do not hover about the opening attempting to return, a habit often displayed by *Deinocerites*. On no occasion did specimens attempt to bite the senior author while he was collecting.

Acknowledgments: The material upon which this paper is based was collected as a part of a general study of the biology of land crabs and their burrow associates (LCBA) being conducted by the senior author and Donald B. Bright, California State College, Fullerton, with the support of a grant from the American Philosophical Society. The collections of *Culicoides barbosai* reported upon herein were made incidentally to a mammalian ectoparasite survey of Costa Rica (Los Angeles County Museum of Natural History) under grant numbers DA-MD-49-193-62-G54 and -63-G94, U. S. Army Medical Research and Development Command.

Sumario

Las larvas, pupas y adultos de una nueva especie de jején, *Culicoides cancer*, han sido descritas y dibujadas basadas en ejemplares colectados en Costa Rica. Este especie es un miembro del Grupo Furens pero se diferencia en su falta de antropofalia y en el medio que usa para desarrollarse, el cual es en los agujeros del cangrejo terrestre, *Cardisoma crassum*.

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